HUMAN REPRODUCTION

Date ___/___/___
Page ___

* Reproduction

- Reproduction is a process by which an organism give rise to offspring.

Reproduction

Sexual	A-sexual
→ 2 parents are involved	→ only one parent
→ fusion of gametes	→ No fusion & form of gamete
→ formation of zygote	→ No formation of zygote
eg: Human	eg: Binary fission

Q. Why reproduction is important?
→ To continue population of species on earth, reproduction is important.

* Types of sexual organism
(on the basis of development & production of foetus)

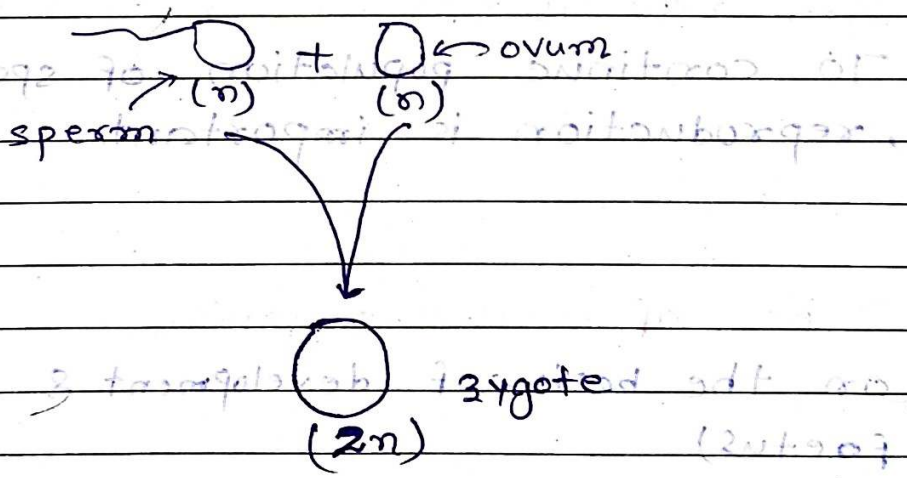
(1) Viviparous
→ Organism that give birth to young ones

(2) Oviparous
→ Organism that lay egg(s)

(3) Ovoviviparous
→ Organism in which the egg(s) develops hatch inside the mother body, but young ones born.

∴ Human are sexually reproducing and vivi-parous organism

* Gamete
→ sex cells, haploid (n) in nature
→ ♂ gamete → sperm
→ ♀ gamete → ovum (pl. ova)



Date ___/___/___
Page ___

* Reproductive events in human

. There are six reproductive events in human

(1) **Gametogenis**
→ formation of gamete
formation of sperm (male gamete) → spermatogensis
formation of ova (♀ gamete) → Oogenesis

(2) **Insemination**
→ Tranfer of sperm in female genital tract is known as insemination

(3) **fertilization / syngamy**
→ fusion of male and female gamete to form zygote is called fertilization.

→ In human fertilization is internal (inside female body)

(4) **Implantation**

Zygote → 2-celled stage → 4-celled stage → 8-16 celled stage (MORULA)

→ Blastocyst

. Implantation stage include formation and development of blastocyst and attachement to the uterus wall (endometrium)

Date ___/___/___
Page _____

- When blastocyst fully embbed (attached) to the uterus wall, it is known as embryo.

(5) Gestation
→ period of embryonic development
→ Organogenesis (form of organ) take place
→ In human, it is of 9 months

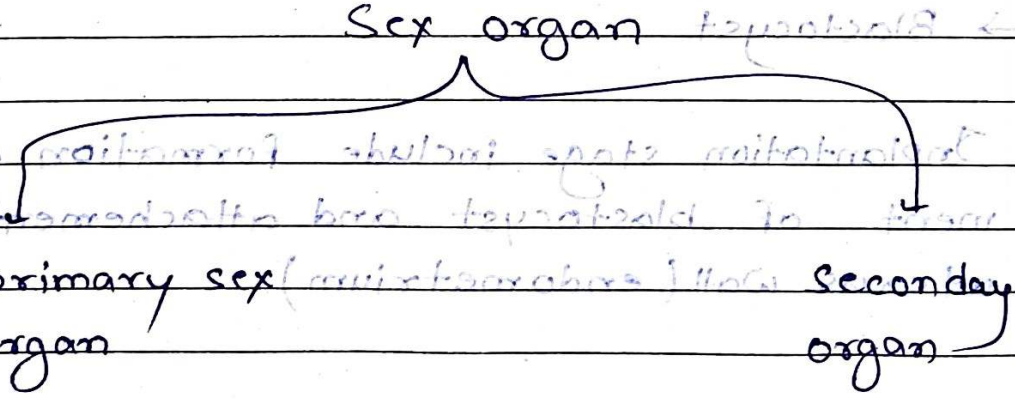
(6) Parturition
→ Delivery of fully developed foetus.

Note:- (i) To maintain ploidy of zygote after fertilization, gametes are haploid in nature

(ii) Sperm formation starts at puberty and continue to the dead.

(iii) Ovum formation starts at embryonic development and stop around the age of fifty years

* Sex organ



Date ___/___/___
Page ___

- Primary sex organ
  → essential sex organ
  → Gametogenesis take place
  → Release sex hormone
  → ♂ → testes
  → ♀ → ovary
  } Developed from mesoderm

- Secondary sex organ
  → Also called accessory sex organ
  → accessory duct, accessory gland and external genitals
  → Help in transfer of gamete

* Secondary sex organ in ♂

(1) Accessory ducts
- It include :- rete testis, vasa efferentia, vas deferens, epididymis and urethra.

(2) Accessory glands
- It includes :- seminal vesicle, prostate and bulbourethral/cowper's gland

(3) External genitals
- It include :- scrotum and ~~testis~~ penis

Date __/__/__
Page _____

* Secondary sex organ in female

(1) Accessory ducts
- It include ÷ falloplan tube/oviduct, uterus, cervix and vagina

(2) Accessory glands
- It include ÷ Bartholin's gland and mammary gland.

(3) External genital
- It include ÷ vulva

* Male reproductive system

- Located in pelvis region
- It is consist of ÷ pair of testes, accessory ducts, accessory gland and external genitalia

* Testes

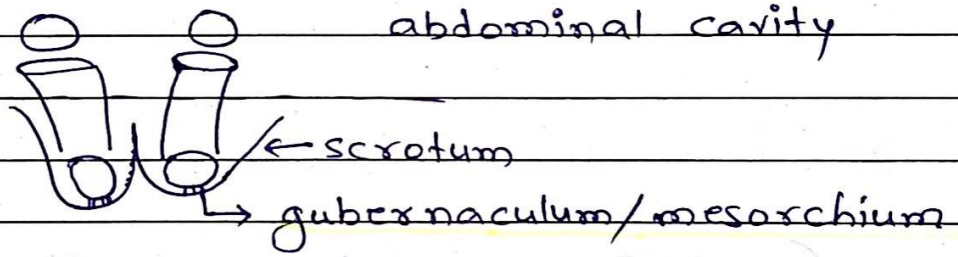
- primary sex organ, one-pair, oval shape
- In adult, length = 4÷5cm, width = 2÷3cm
- located outside abdominal cavity, in a pouch called scrotum
- Scrotum provide 2-2.5°C less tem. than body tem to testes for spermatogenesis.

Date ___/___/___
Page ___

Extra

- During embryonic life, tetes is present in abdominal cavity. In 7th months of pregnancy, testes decend down in scrotum (outside the abdominal cavity) through inguinal canal.

- If testes failed to descend in scrotum, this condition is known as **cryptochildism** (lead to sterility). To treat cryptochildism, **Orchiopexy** is done
  ↳ through surgery testes is descend in scrotum.



- Testes is attached to scrotum through guber-naculum

- for thermoregulation, scrotum has Dartos muscle and Cremaster muscle. During summer, these muscles, ~~contract~~ relax and move testes away from body. During winter, these muscles contract and move testes towards body.

Date ___/___/___
Page ___

* Internal structure of testes

- There are three covering of testes
  (i) Tunica vaginalis [outermost, double, incomplete]
  (ii) Tunica Albuginea [middle, thick]
  (iii) Tunica vascularis [innermost, provide blood supply]
- Each testis has 250 compartments called testicular lobules. Septum of testicular lobules is formed by Tunica Albuginea
- In each testicular lobule 1-3 seminiferous tubules are present where spermatogenesis occur

* T.S of testies

- Seminiferous tubule on its inside lined by two types of cells.

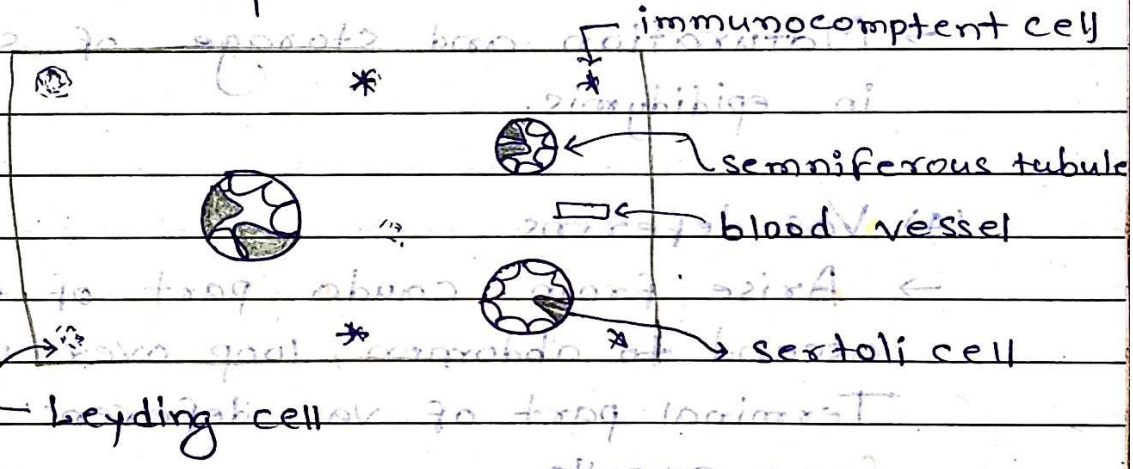
(i) Spermatogonia or male germ cell or sperm mother cell (cuboidal cell)
→ Undergo meiotic (meiosis) division to form sperm

(ii) Sertoli cell or Nurse cell or subtentacular cell (columnar cell)
→ provide nourishment to germ cell
→ form blood testes barrier

→ provide anti-mullerian factor
→ provide Androgen binding protein

- The space outside seminiferous tubule is called Interstital space

- Interstital space contain :-
(a) Leydig cell / Interstital cell
↳ provide androgen, mainly testosterone
(b) Small blood vessels
(c) Immuno comptent cell



T.S of testes (testicular lobule)

* Male accessory duct

(1) Rete testies
→ Network formed by end part of semiferous tubule (straight structure) is called rete testis

Testis (pl. testes)

Date ___/___/___

Page _____

(2) Vasa efferentia / Efferent ductule

→ Carry sperm from rete testes to epididymis

→ It leave testis

(3) Epidymis

→ 6m long, coiled tube located on posterior side of each testis.

→ It has three parts :- (i) Caputa epididymis (head) (ii) Corpus epididymis (body) and (iii) Cauda epididymis (tail)

→ Maturation and storage of sperm occurs in epididymis.

(4) Vas deferens

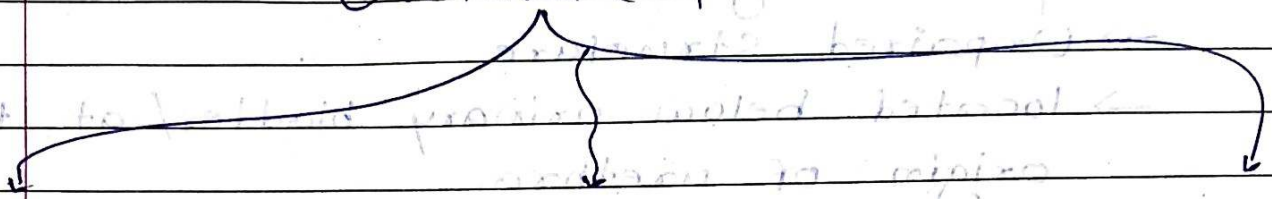
→ Arise from cauda part of epididymis and ascend to abdomen, loop over urinary bladder. Terminal part of vas deferens is dilate and form ampulla.

→ Ampulla recieve duct from seminal vesicle and form ejaculatory duct.

. Ejaculatory duct open into urethra

Date ___/___/___
Page ___

Urethra (3 parts)



(i) prostatic urethra (ii) membranous urethra (iii) penile urethra

- Sperm travel through urethra/ urinogential duct and comes out through an opening called urethral meatus.

* Male accessory glands

There are three male accessory glands in male which release seminal plasma

(1) **Seminal vessicle**

→ paired structure

→ present at junction of vas deferens and prostate, Behind urinary bladder

→ Secrete seminal fluid which is slightly alkaline in nature (pH = 7.3)

→ Seminal fluid contain fructose, certain enzymes (fibrinogen, prostaglandin)

→ Contribute 60-70% of semen

Date ___/___/___
Page _____

(2) Prostate gland
→ Unpaired structure
→ located below urinary bladder/ at the origin of urethra.
→ Secrete prostatic fluid which is slightly acidic in nature (pH=6.5)
→ prostatic fluid contain citric acid, Ca^{2+}, It help in maturation & mobility of sperm.

(3) Bulbourethral gland
→ Also known as Cowers gland
→ paired structure
→ Beneath prostate, behind urethra
→ During sexual activity, it helps in lubrication of penis.
→ Slightly alkaline (pH=7.2)

* Semen
→ Semen = sperm + seminal plasma (fluid part of semen secreted by accessory glands) ← rich in fructose, calciums & certain enzymes.
→ Slightly alkaline pH
→ During single ejaculation, male release 200 – 300 million sperm.
→ 3-4 ml semen is released
→ For normal male fertility 60% of ejaculated sperm should have normal shape and size. And 40% of them must have vigrous motility
→ Sperm count = 22 – 120 million/ml

Date ___/___/___
Page _____

* Male external genitalia

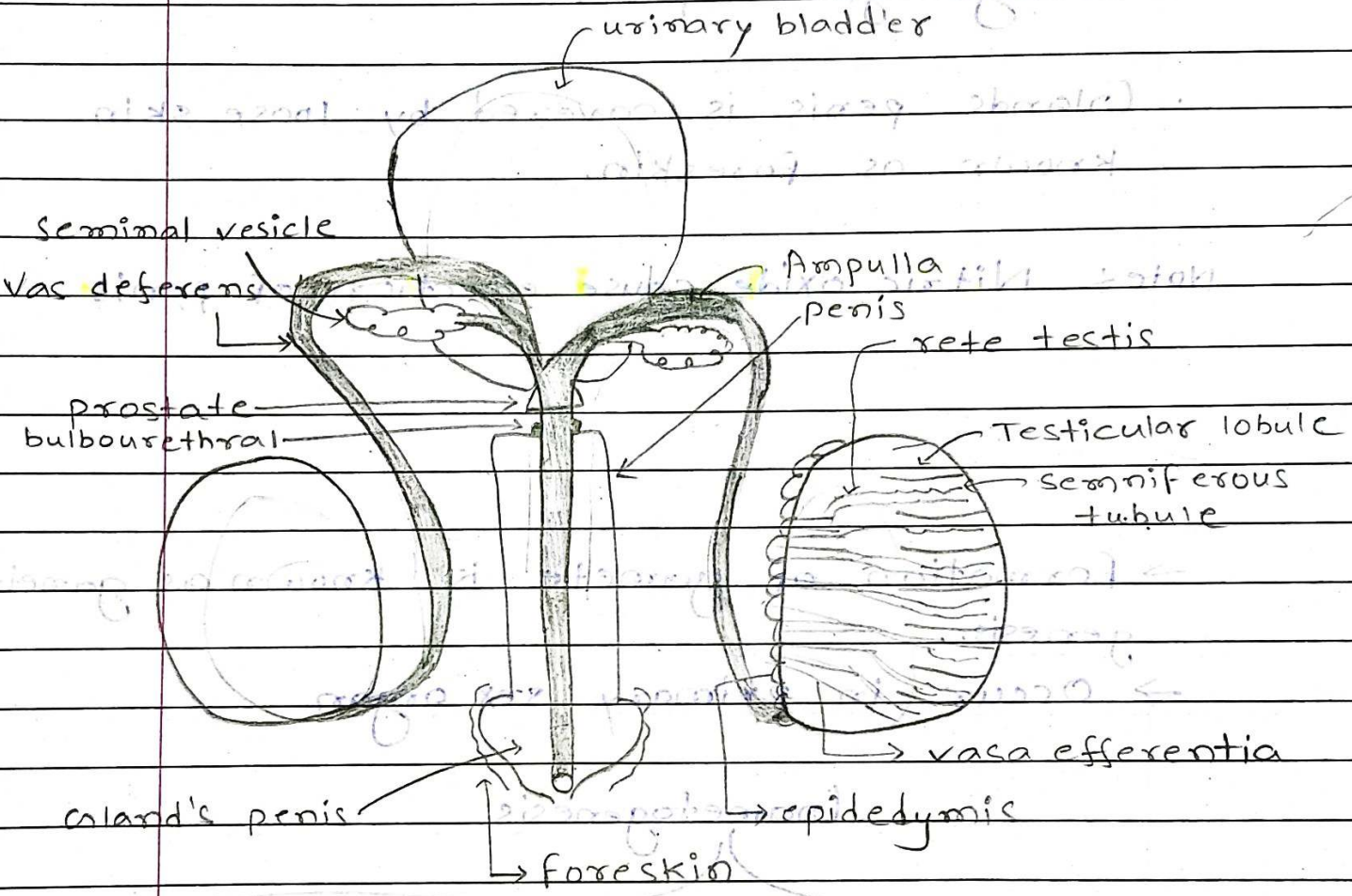


Diagram of male reproductive system

- Penis is the male external genitalia through which copulation is done.
- penis has special erectile tissue which help in insemination.
- The large end part of penis is known as glands penis.

Date ___/___/___
Page _____

- During erection, blood flow in vessels increase which cause erect penis and enlarge glands penis.
- Glands penis is covered by loose skin known as foreskin.

Note :- Nitric oxide cause erection of penis.

* Gametogenesis

→ formation of gamete is known as gameto genesis.
→ Occur in primary sex organ.

Gametogenesis

(i) Spermatogenesis (ii) Oogenesis

(1) Spermatogenesis

→ occur in male
→ location :- in testes (seminiferous tubule)
→ formation of sperm is known as spermato-genesis.
→ Contine even in old age

Date ___/___/___
Page ___

(2.) Oogenesis

→ Occur in female
→ location - ovary
→ formation of ova is known as oogenesis
→ Start during intra uterine life/embryonic stag
→ end at menopause (around 45-50 year age)

* Stage of gametogenesis

• Three 3 Stage in gametogenesis.

(i) Multiplication phase

→ In this phase, spermatogonia or oogonia divide mitotically and increase their number

(ii) Growth phase

→ ~~primary~~ primary spermatocyte and primary oocyte is form by cytoplasmic growth.

(iii) Maturation phase

→ In this phase, maturation take place

* Spermatogenesis

→ Spermatogonia/sperm mother cell/male germ cell divide mitotically and increase their number [Multiplication phase]

Date ___/___/___
Page _____

→ Few spermatogonia grow in size and form primary spermatocyte [Growth phase]

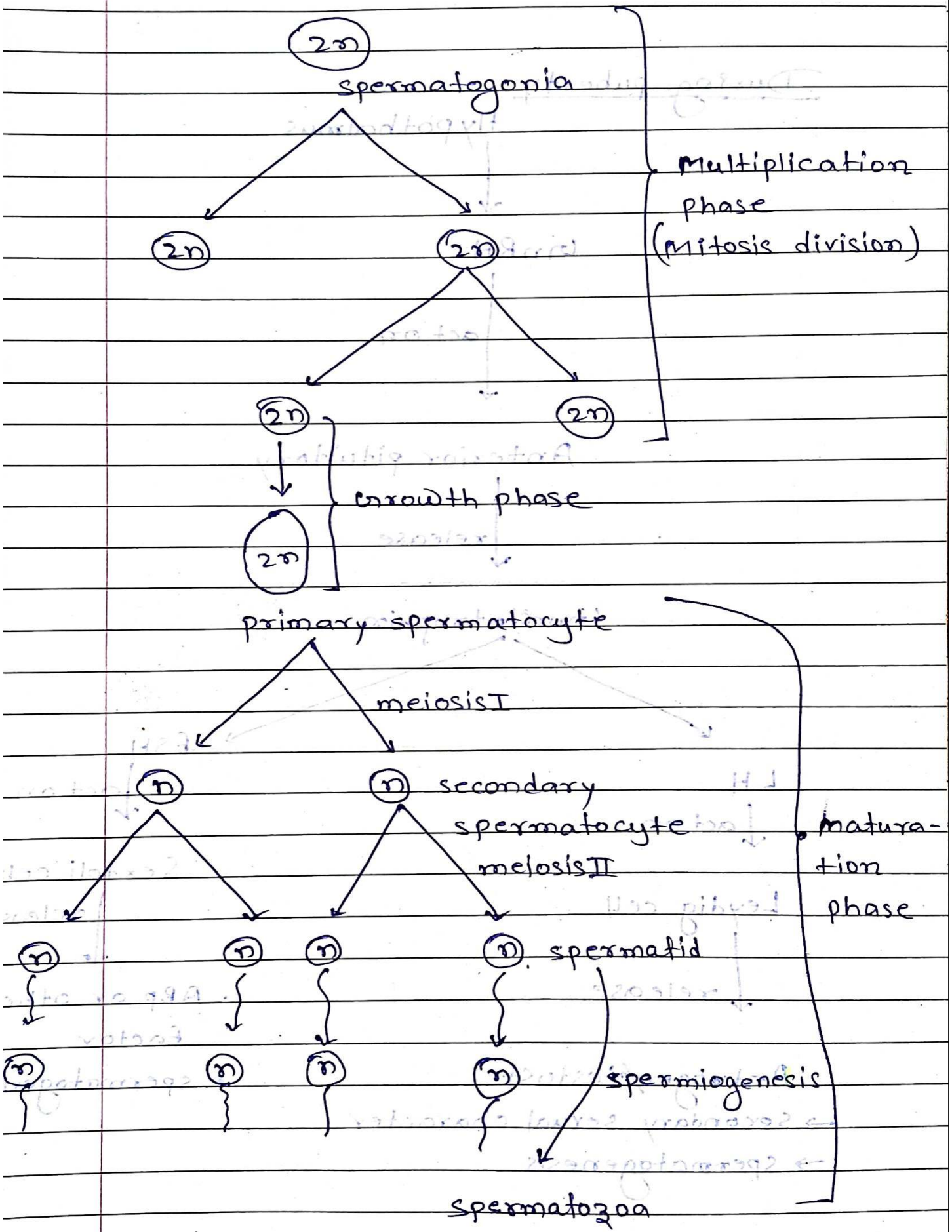
→ primary spermatocyte undergo meiotic I (reductional division) to form 2 equal, haploid, secondary spermatocytes [chromosome number gets halved]

→ Secondary spermatocytes undergo meiotic II (equational division) to form 2 equal, haploid spermatids (chromosome number remain same)

→ Spermatid transform into spermatozoa by the process spermiogenesis.

→ The head of spermatozoa get embbed in Sertoli cell and derive nutrition from it. After that it get release from seminiferous tubule. This is known as spermiation

→ Longest phase in spermatogenesis ⇒ Maturation phase


2n
spermatogonia
2n
2n
2n
2n
Multiplication phase (mitosis division)
growth phase
2n
primary spermatocyte
meiosis I
n
n
secondary spermatocyte
meiosis II
maturation phase
n
n
n
n
spermatid
n
n
n
n
spermiogenesis
spermatozoa

Date ___/___/___
Page _____

* Hormonal regulation in spermatogenesis

During puberty

Hypothalmus

↓

GnRH

↓ act on

Anterior pituitory

↓ release

Gonadotrophin

↙ ↘

LH

↓ act on

Leydig cell

↓ release

Antrogen/testostrone

→ secondary sexual character

→ spermatogenesis

FSH

↓ act on

Sertoli cell

↓ release

· ABP or other factor

? spermatogenesis

Date ___/___/___
Page ___

- Excess spermatogenesis cause release of Inhibin from sertoli cell which give -ve feedback to hypothalmus & Anterior pituitory

- Excess spermatogenesis will give -ve feedback to hypothalmus & anterior pituitary from Leydig cell

* Structure of sperm

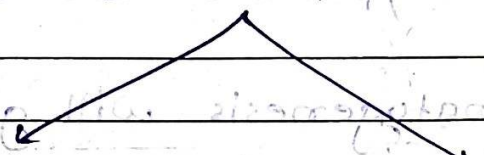
→ Microscopic structure
→ consist of 4 parts - Head, neck, middle piece and tail

(1) Head

→ Anterior part of head has cap like structure called acrosome
→ Acrosome is filled with enzyme (sperm lysin) that help in penetrating the protective covering of ova.
→ Acrosome is formed by condensation of golgi body
→ posterior part of head has haploid elongated nucleus

Date ___/___/___
Page _____

(2) Neck
→ Short part b/w head and middle piece
→ It has 2 centriole



proximal centriole
→ Help in divⁿ of zygote

Distal centriole
↳ form axial filament

(3) Middle piece
→ Known as energy chamber of sperm b/c it has numerous (25-30) mitochondria which provide energy for motility of sperm.

→ The mitochondria is arranged spirally which forms Nebenkern sheath.

(4) Tail
→ provide motility to sperm

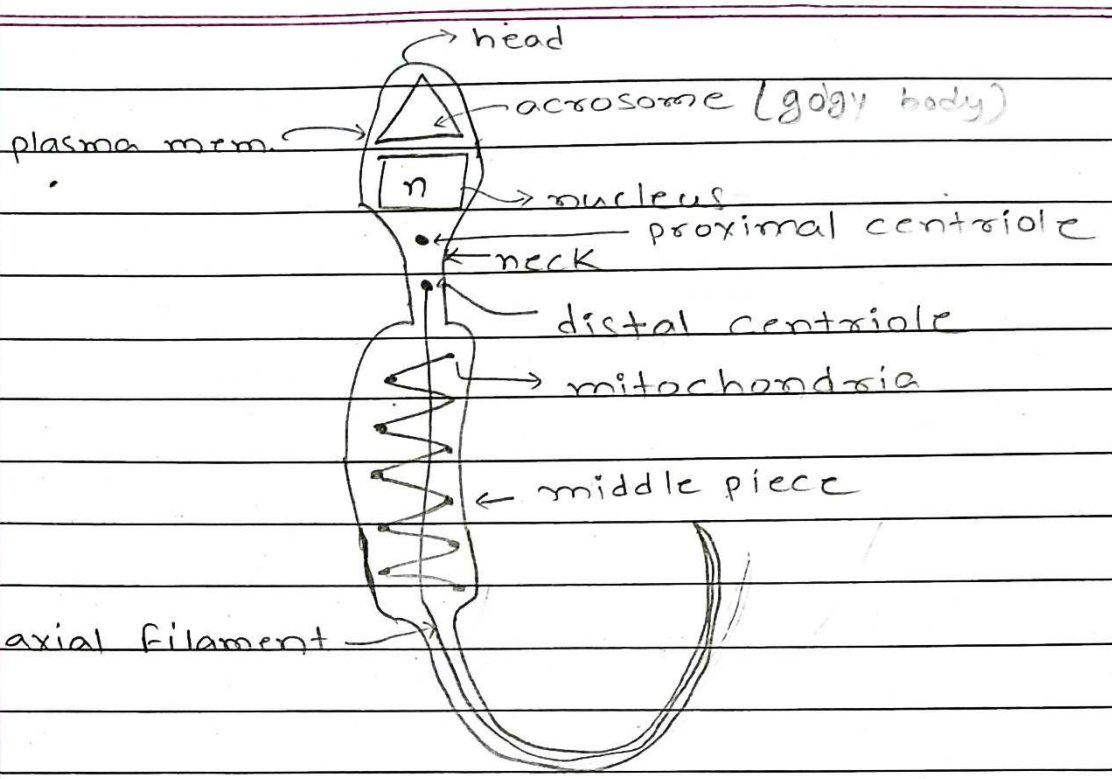
note :- 46/23 pair

22 pair outsome
→ same in ♂ & ♀

one pair allosome/sex chromosome different in male and female
♂ = XY
♀ = XX

sperm
ova (X)
(X) (Y)

Date ___/___/___
Page ___



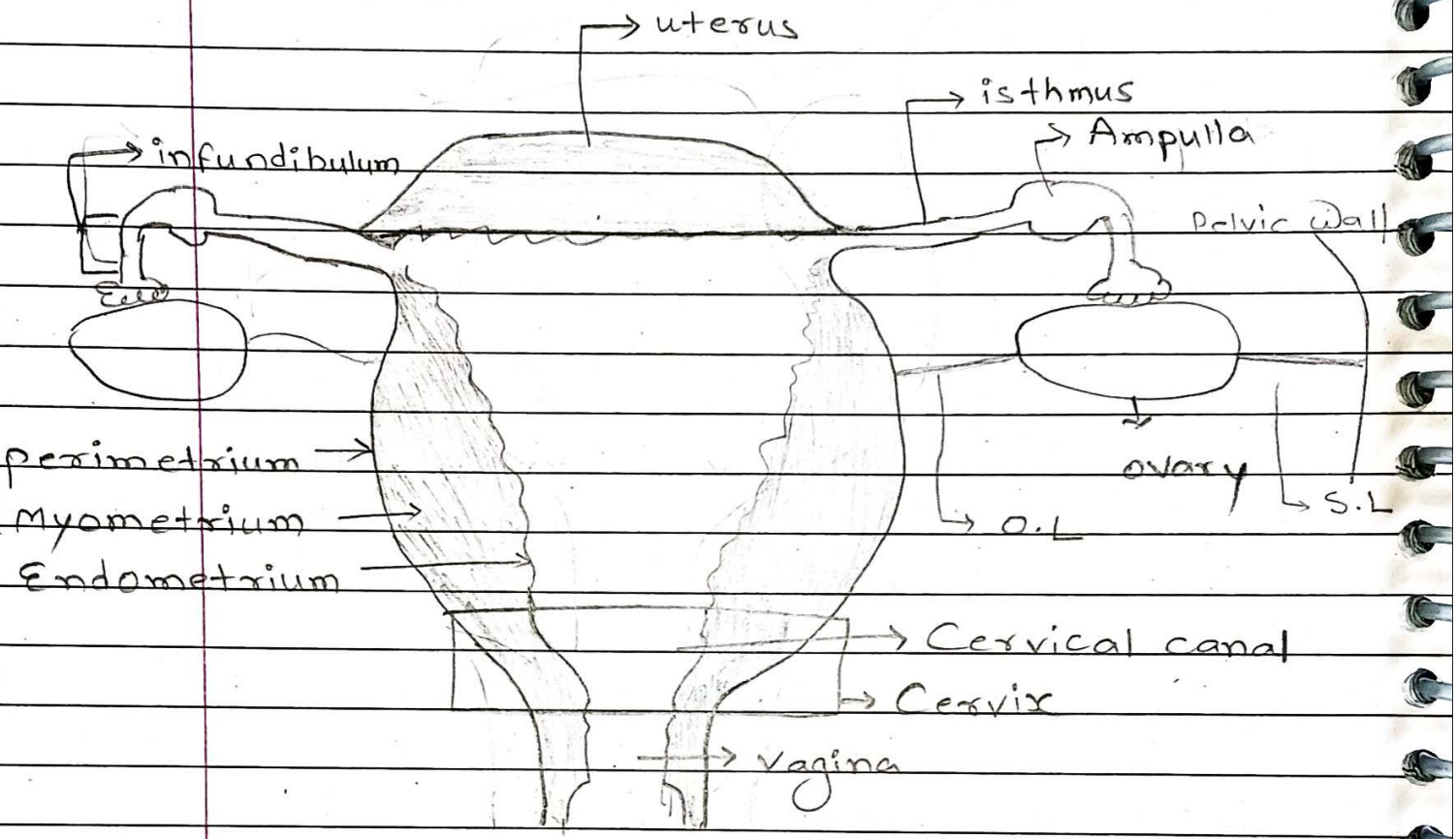
Structure of sperm

* Female reproductive system

- It consist of primary sex organ (ovary), ♀ accessory duct (fallopian tube, uterus, cervix, vagina), ♀ accessory gland and ♀ ~~etc~~ external genitalia known as vulva (mons pubis, labia majora, Labia minora, clitoris, hymen)

Note :- Along with these, one pair of mammary glands, structurally & functionally support ovulation, fertilisation, pregnancy &, childbirth & child care

Date ___/___/___
Page ___

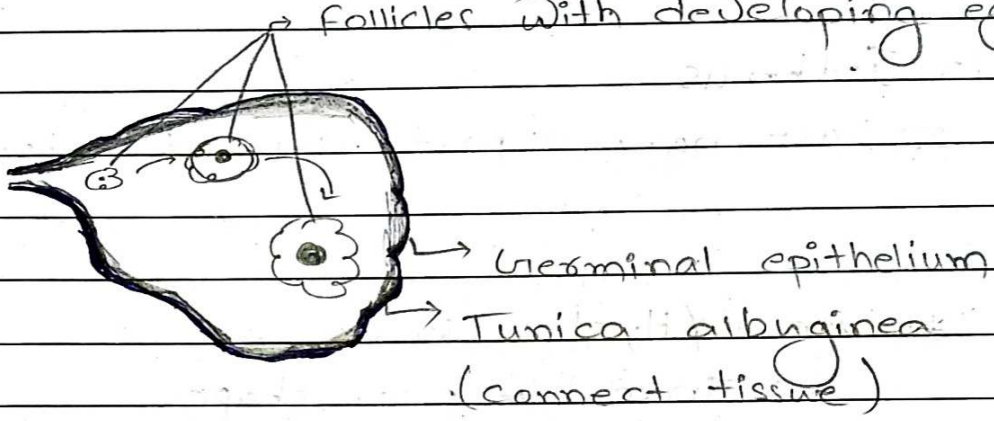


- Ovary is attached with uterine wall through ovarian ligament and with pelvic wall through suspensory ligament.

* Ovary
  - ↳ covering = thin germinal epithelium.
  - primary sex organ, one pair, ~~teth~~
  - length = 2 to 4 cm, 1° sex organ
  - it produce ♀ gamete (ovum) & ovarian hormone (progesterone and estrogen)

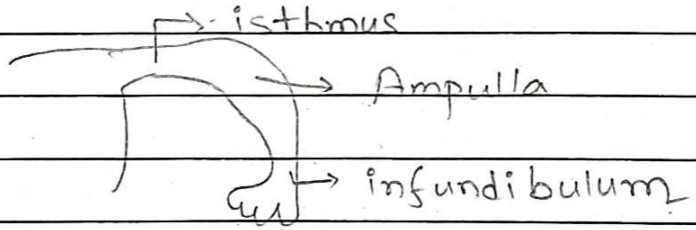
Date ___/___/___
Page ___

- Entire space inside ovary is called 'Stroma' & it is further divided into two parts
  (i) Cortex (outer) → has follicle
  (ii) Medulla (inner) → blood vessels



* Fallopian tube / oviduct

- Ciliated columnar epithelium
- Length = 10–12 cm



- There are three parts of oviduct.

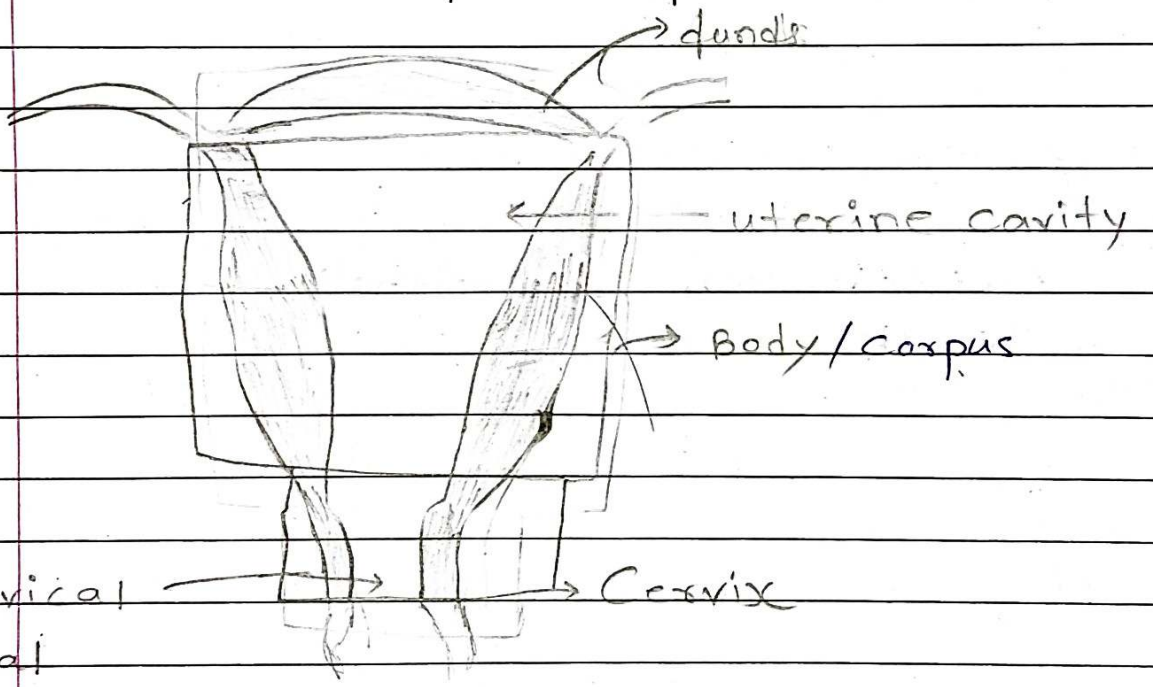
(1) Infundibulum
→ funnel like structure
→ finger like projection emerge from infundibulum called fimbriae to collect ova.

Date ___/___/___
Page _____

(2) Ampulla
→ Wider part of fallopian tube where fertili-sation occurs

(3) Isthmus
→ Last, narrow part, close to uterus.

* Uterus / Hystra / Womb
↳ Inverted pear shape



• parts of uterus

→ It has three parts
(i) Funds
→ Top, dome shaped, where implantation occurs (specially in endometrium)

(ii) Body
→ Middle part

(iii) Cervix
→ Last, narrow part of uterus

- Wall of uterus
→ There are three wall/layer of uterus

(i) Perimetrium (C.T + E.T, thin)
→ Outermost layer

(ii) Myometrium: (Thick)
→ Middle layer, has smooth muscles, which contracts upon action of oxytocin & help in childbirth.

(iii) Endometrium (Glandular)
→ Innermost & highly vascular
→ Undergoes maxium changes during menstrual cycle.
→ Every month, it prepares for pregnancy by thickening under influence of estrogen.

→ But if pregnancy does not happen, it breaks in the form of menstrual blood.

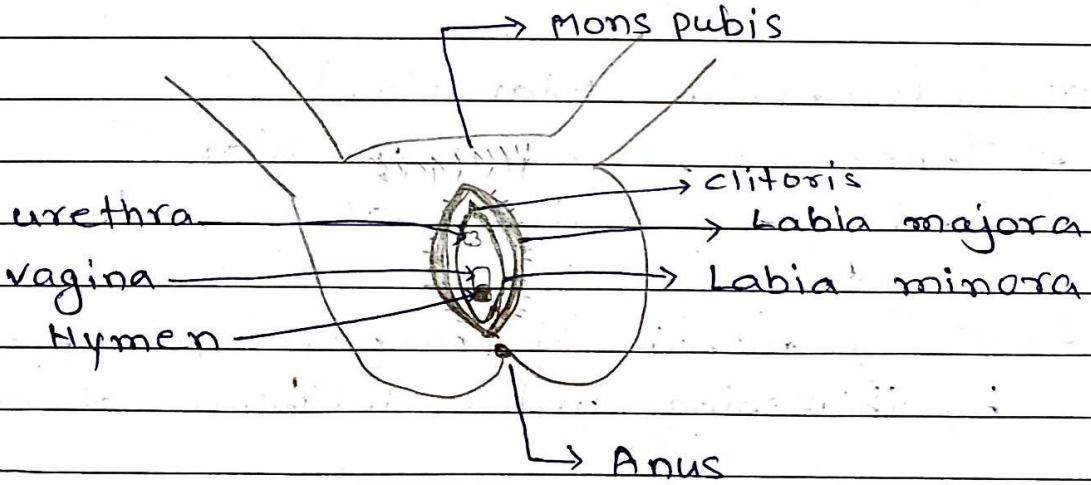
Date ___/___/___
Page _____

Extra

Endometrium has 2 layer :-
(i) Stratum basalis (ii) Stratum functionalis
. Stratum functionalis break during period

* Vagina
→ This is the copulatory canal
→ Along with cervical canal it forms — Birth canal.

* Female external genitalia
→ Also known as Vulva
→ It consist of :- Mons pubis, Labia majora, Labia minora, clitoris and hymen.



Date ___/___/___
Page ___

(1) Mons pubis
→ Cushion of fatty tissue covered with skin & pubic hair

→ Homologous organ with scrotum

(2) Labia majora
→ paired fold of tissue that extends from mons pubis, with pubic hair surrounds the vaginal oriffice (opening)

(3) Labia minora
→ paired & fold of tissue under majora, no pubic hair.

→ Homologous with penis

(4) Clitoris
→ Tiny ~~fig~~ fingure like structure present at the junction of 2 Labia minora just above the urethral opening.

(5) Hymen
→ Membrane that partially covers vaginal oriffice

→ It may or maynot be a part of ♀ external genitalia

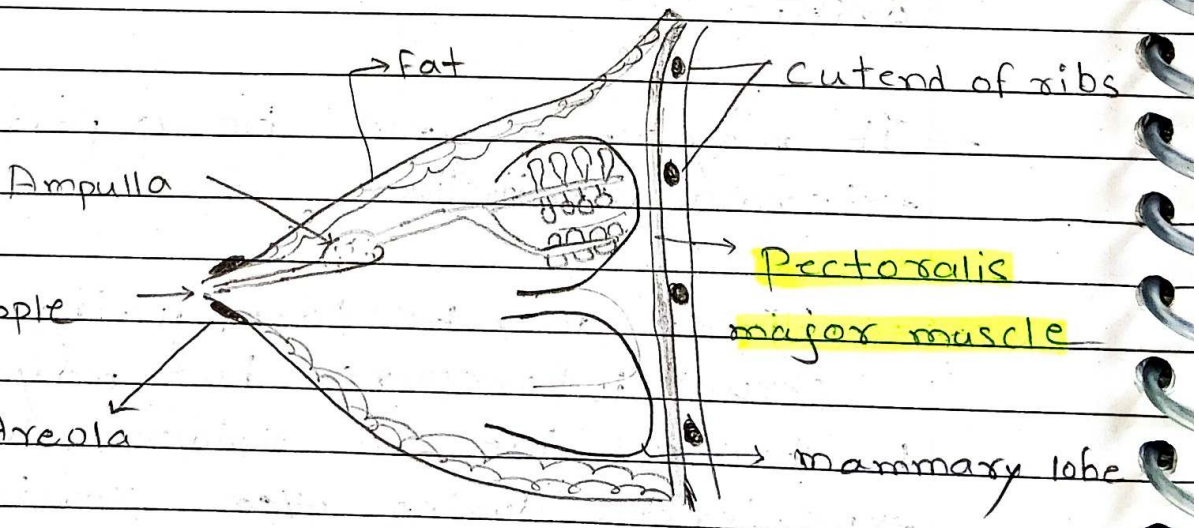
Note :- Hymen may be torn during the 1st sexual intercourse but may also be broken due to sudden joint or fall experienced during ~~exer~~ exercise/cycling /horse riding & also due to insertion

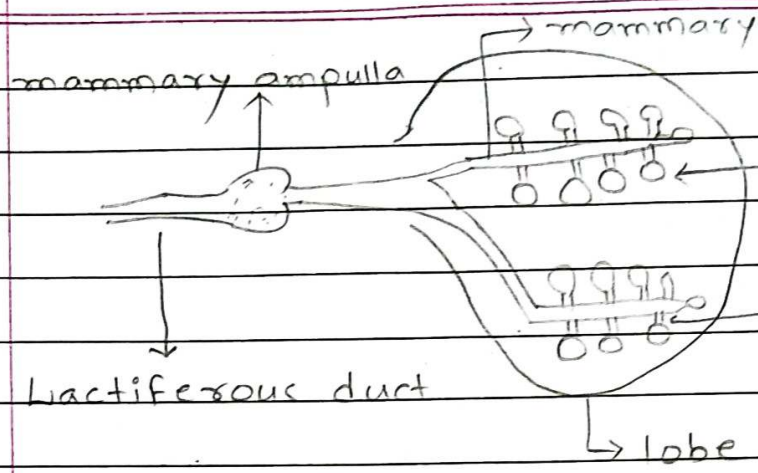
Date ___/___/___
Page ___

of menstrual cup/tampons during period

* Mammary gland

- functional mammary gland is the characteristic feature of ♀ mammals
- one pair, modified sweat/sudorific gland
- Location: on pectoralis major muscle
- mammary glands has variable amount of fat & glandular tissue
- At puberty mammary gland grow under influence of estrogen.
- During pregnancy mammary gland grow under influence of prolactin, progesterone





- Glandular tissue of each mammary gland is divided into :-

↓

15 - 20 mammary lobes

↓

Each lobe has clusters of milk forming structures known as mammary alveoli & also store milk.

↓

from alveoli milk carried via mammary tubule

↓

M. tubule goins to form mammary ducts

↓

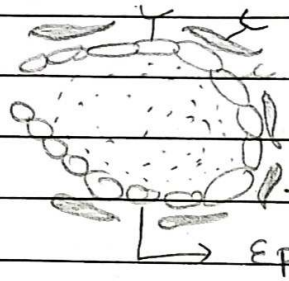
M. Ducts goins to form a wider mammary ampulla.

↓

Ampulla leads to Lactiferous duct that open into nipple from where milk is sucked

Date ___/___/___
Page ___

* Mammary alveoli



- Prolactin hormone acts on epithelial cell of alveoli to synthesis milk.
- Oxytocin hormone acts on myoepithelial cell to contract epithelial cells of alveoli

* Lactation

→ The process of synthesis of milk is called Lactation
→ Occur during end of pregnancy.

- The milk produced during initial few day of lactation is called Colostrum which contains several antibodies (IgA) absolutely essential to develop resistance for new born babies

PROLACTIN

growth of mammary gland during pregnancy

Lactation

Colostrum (yellow)

Date ____/____/____
Page _____

* Oogenesis

- formation of mature ova is called oogenesis
- Initiated during embryonic life
- Ends at Menopause (45–50 age)

note: Oogenesis is markedly different from spermatogenesis.

- Oogenesis in terms of 'oocyte'

embryonic life

→ oogonia/gamete mother cell

↓ mitosis

oogonia number increase

↓

grows enter in meiosis I, which get arrested in diplotene stage of prophase I called primary oocyte (2n)

During puberty

→ 1° oocyte complete meiosis I & large, haploid 2° oocyte and tiny haploid 1st polar body.

↓

Date ___/___/___
Page ___

2° oocyte enters in meiosis II and get arrested at metaphase II

if sperm is there meiosis II get completed which form large, haploid ova and tiny, haploid 2nd polar body

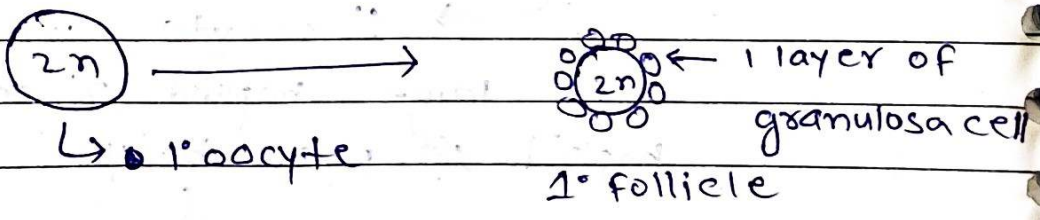
If sperm is not there, meiosis II will not get completed causing bleeding phase of menstrual cycle

. ova & sperm fuse which cause pregnancy

. Oogenesis in terms of 'follicles'

foetal ovary

→ 1° oocyte arrested in diplotene stage of prophase I & get surrounded by 1 layer of granulosa cell and become 1° follicle

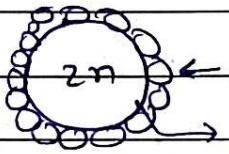


Date ____/____/____
Page ____

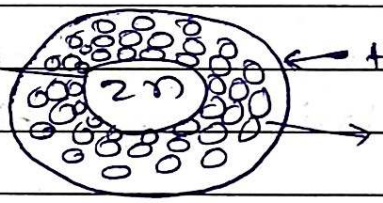
Puberty
↳ growth of follicle take place under the action of FSH

1° follicle → 2° follicle → 3° follicle → graffian/mature follicle

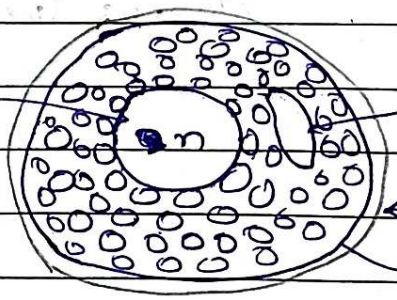
- 1° follice → 1° oocyte surrounded by 1 layer of GC



- 2° follicle → 1° oocyte surrounded by multiple layer of GC & theca layer is formed



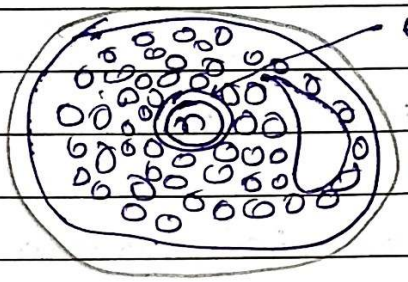
- 3° follicle → mieosis -1 completed which lead to formation of 2° oocyte
  → Antrum (fluid - filled cavity) form
  → Theca organise into → Theca externa
  ↳ Theca interna



Date ___/___/___
Page _____

- Graffian/mature follicle

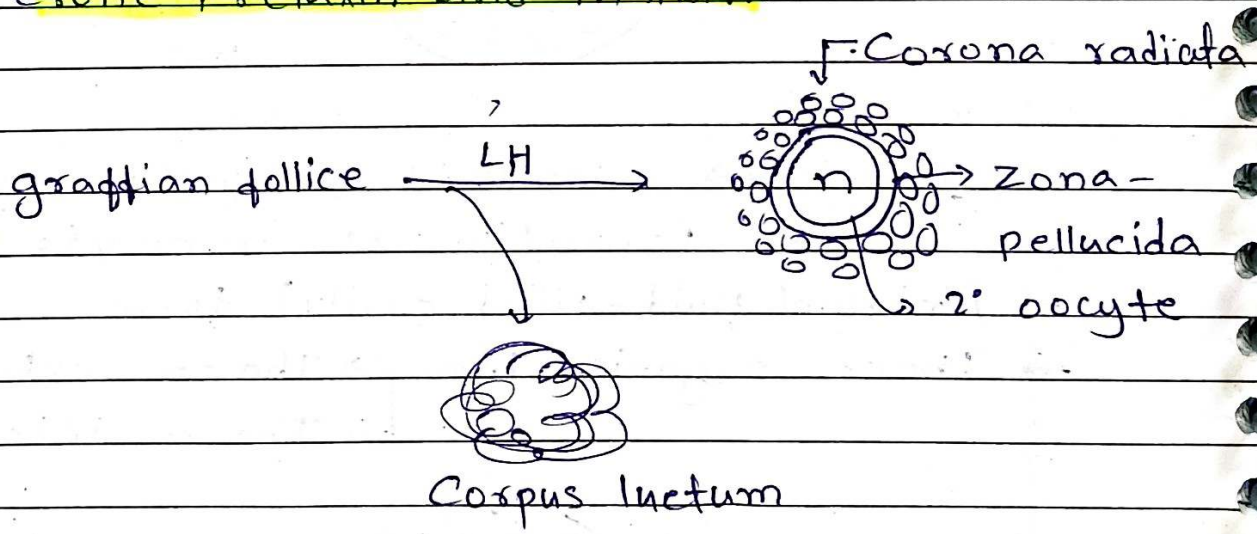
→ zona pellucida form around 2° oocyte & Antrum enlarge



→ LH acts on graffian follicle and cause rupturing of it, releasing of 2° oocyte

→ Remain ruptured part of graffian follicle form Corpus luteum (yellow body, lutein pigm)

→ Corpus luteum secrete ÷ Estrogen, progesterone, relaxin and inhibin.



Date ___/___/___
Page ___

Note:- (i) No more oogonia are added after birth
(ii) From birth to puberty many 1° follicle - degenrate [follicular attresia]

(iii) In puberty only 60K - 80K 1° follicle are present in each ovary

(iv) In oogenesis, meiosis I and meiosis II is unequal division (in term of cytoplasm)

(v) 1 primary oocyte form 1 ova

(vi) Zona pellucida is non-cellular layer, made of Glycoprotein, Corona radiata is cellular layer (Granulosa cell)

~~(vii)~~

(vii) Meiosis I complete → in 3° follicle

(viii) meiosis II complete → after entry of sperm or before fertilisation

→ Secreted by oocyte & follicular cell

Note:- During the rupturing of graafiane follicle it gives -ve feedback to FSH. After form of corpus leteum progestrone gives -ve feedbact to LH

Date ___/___/___
Page ___

- Oogenesis

Foetal ovary → oogonia → mitosis → number increase → oogonia grow in size and form 1° oocyte → 1° oocyte enters in meiosis I and get arrested at diplotene stage of prophase-I → 1° oocyte converted into 1° follicle

puberty → 1° follicle → 2° follicle → 3° follicle → M-I complete & 2° oocyte form → 2° oocyte get arrested at metaphase II of meiosis II

Date ___/___/___
Page ___

graffian follicle

rupture by LH

Corpus luteum

2° oocyte

+ sperm
- meiosis II complete
- fertilisation & pregnancy

- sperm
- bleeding phase of menstrual cycle

* Menstrual cycle

Mammal

primate

→ ♀ primate undergo menstrual cycle

Non- primate

Date ___/___/___
Page ___

- Non-primate

→ ♀ non-primate undergo estrous cycle in which during breeding season, level of estrogen increase which cause sex urge & copulation

→ Estrogen cycle is suspended in non-breeding season.

- Reproductive cycle of ♀ primate mammal is called Menstrual cycle. It includes events from 1 menstruation to next menstruation.

- Average menstrual cycle = 28-29 days

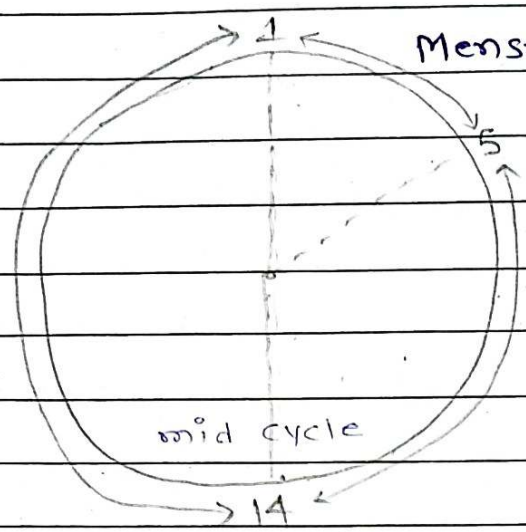
- Menarche → 1st menstruation (start at puberty)

- Menopause → last menstruation (45-50 years)

- Events of Menstrual cycle is seen at :-

ovary	uterus
① follicular phase	① Menstrual phase
② Ovulatory phase	② proliferative phase
③ leutal phase	③ Secretry phase

Date ___/___/___
Page ___



- Menstrual phase
  - → Take place in uterus
  - → In this phase, endometrial lining alongwith blood vessels comes out in the form of blood from vaginal opening.
  - → It last for 3-5 days
  - → It is also known as bleeding phase
  - → Level of GnRH, LH, FSH, estrogen, progesterone is less during this phase

- follicular and proliferative phase (→ ovary, → uterus)
  - → During this phase, GnRH increases, due to which FSH & LH also increases
  - → FSH cause development of follicle
  - 1° — 2° → 3° → Graffian follicle

Date __/__/__
Page

→ Growing follicle release estrogen (by GC)

→ Estrogen cause regeneration of endometrium (proliferation of endometrium)

→ At 13th day estrogen is at its peak which give +ve feedback to LH and FSH

- Luteal phase/secretory phase

→ After ovulation, ruptured graffian follicle form Corpus luetum.

→ Corpus leuetum secrete → estrogen (less)
progesterogne (mainly, high)
inhibin, relaxin

→ Estrogen and progestrone together give -ve feedback to LH and FSH due to which level of LH and FSH decreases in this phase

→ Estrogen & progesterone make endometrium more vascular and form glands in them which mucus and other substance.

→ life span of Corpus leuctum is fixed (14 days)

→ After 14 days corpus luctum tranform into cropus albican (no progesterone is secreted)

→ As level of progesterone falls, endometrial lining again breaks and next menstrual phase begin

Date ___/___/___
Page ___

Note:-

① Endometrium maintain by progesterone

② There are two possibilities :- (After ovulation)

Sperm ✓

↓

fertilization, implantation

↓

placenta form

↓

Secrete progesterone which maintain Endometrial lining for 9 months.

Sperm X

↓

C.L will degenrate after 14 days, due to which progesterone level decrease which cause disintegration of Endometrium lining (Menstrual phase of next MC)

→ During pregnancy, events of MC is suspended

→ Menstrual phase occurs only if release ova is not fertilised

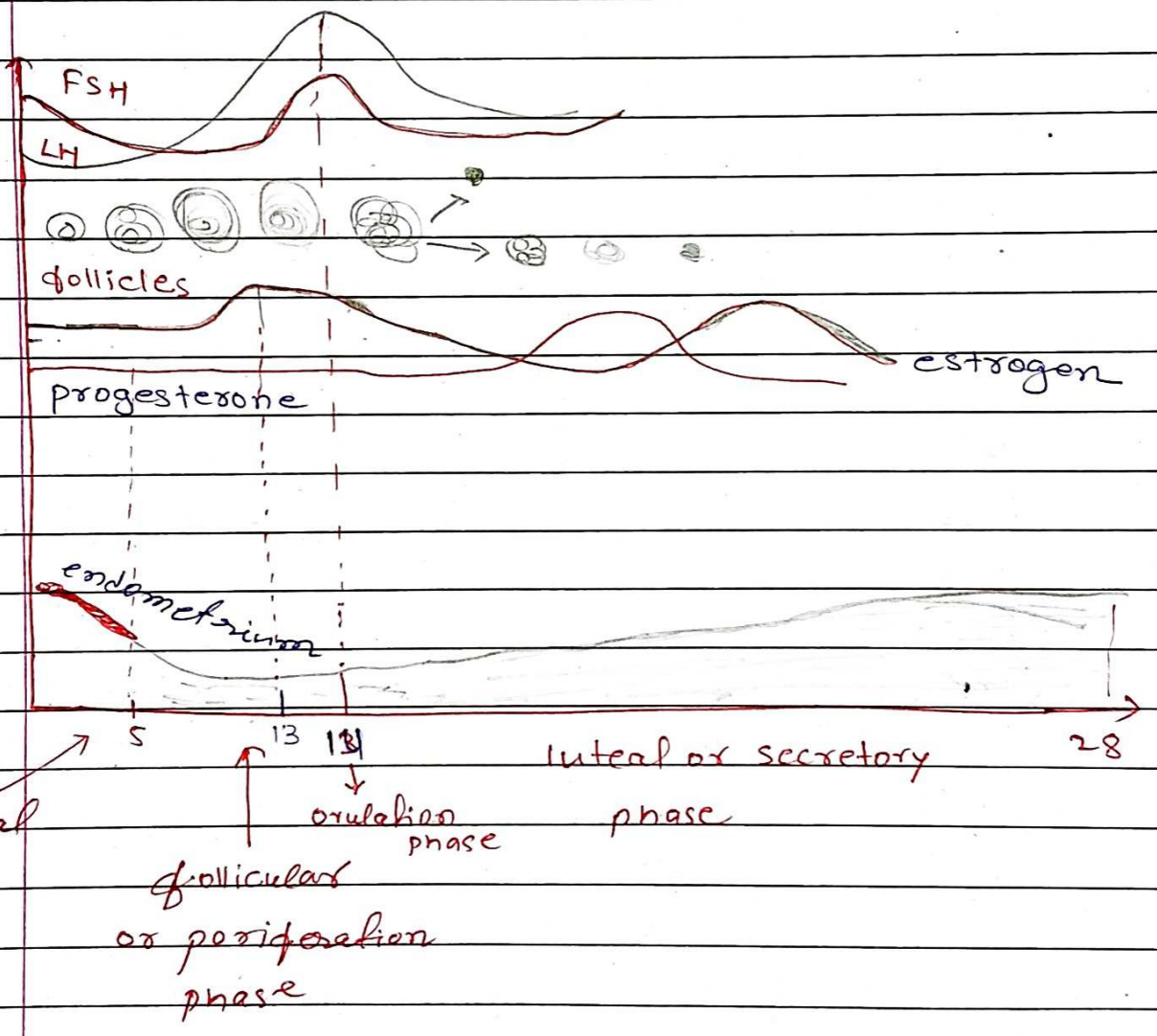
→ Lack of menstruation, may be an indication of pregnancy But many other factors like stress, health condition, lifestyle of a female affects her MC.

Date ___/___/___
Page _____

→ Hygiene is very necessary during Menstruation

→ Fixed period of event in Mc ÷ luteal phase or secretory days (14 days after ovulation)

→ Corpus luteum —Transform→ Corpus albican
yellow body white body



Date ___/___/___
Page ___

* fertilisation

- fusion of male and female gamete to form diploid, single celled zygote is called fertilization.

- fertilization is possible only when copulation is done at the time around ovulation. So, that male and female gamete both are transported simultaneously to the ampulla of fallopian tube

- In female reproductive tract capacitation of sperm take place

- **Capacitation**

→ Capacitation is the process by which changes in sperm is made that makes the sperm able to fertilize ova

- Steps in capacitation in sperm:-
  (i) removal of cholesterol layer from acrosome of sperm
  (ii) Dissolve decapacitation factor
  (iii) Entry of Ca^{2+} in sperm which cause whiplash movement of tail in sperm

Date ___/___/___
Page ___

Male

inseminate his sperm in vagina

Capacitation of sperm occur

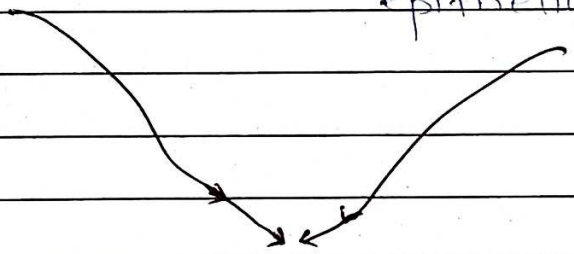
Sperm moves from vagina to ampulla

Female

Ovulation occur, releasing 2° oocyte in abdominal cavity

~~reach am~~ 2° oocyte enters in fimbriated infundibulum through ostium

reach ampulla due to ciliated epithelium of fallopian tube



Both sperm and 2° oocyte meet at ampulla

Meiosis II and fertilization occur

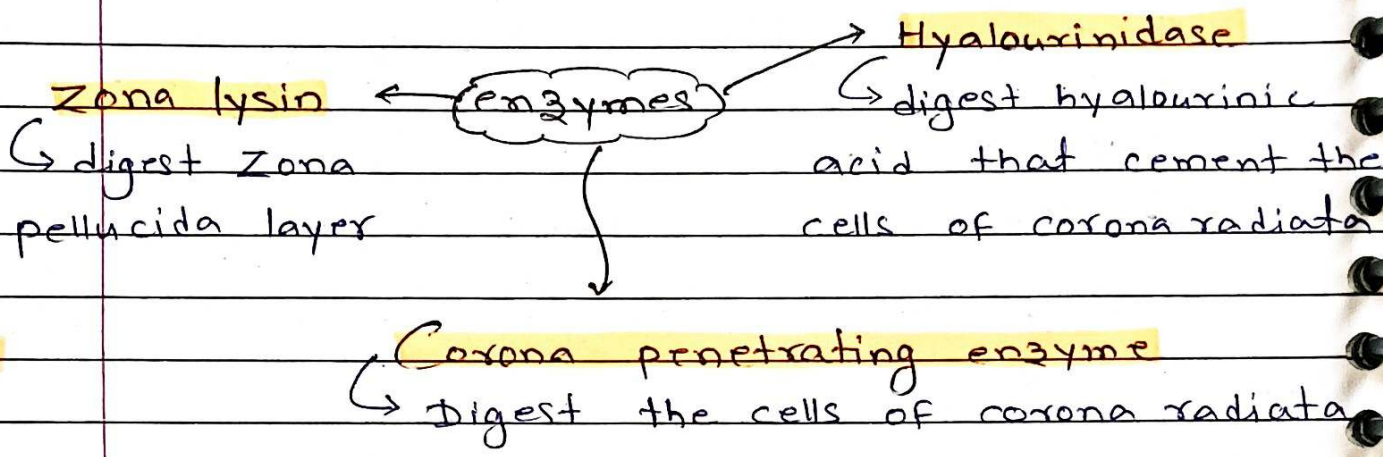
Q. How fertilization occur?

⇒

- Acrosomal reaction

→ Acrosome has several enzyme which help in digestion of protective layer present around 2° oocyte

→ Due to these enzymes, pathway for entrance of sperm is formed in 2° oocyte



- As the sperm head touch the plasma mem. of 2° oocyte, meiosis II resume and get completed, which result in the formation of ova. Nucleus of ova and sperm fuse to form zygote

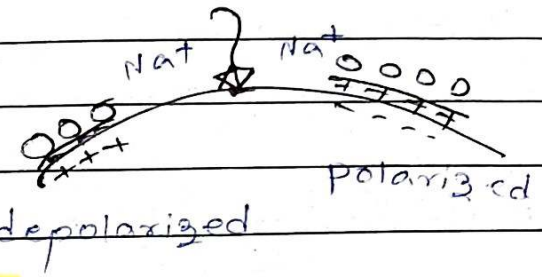
- **polyspermy**

polyspermy is a condition where single ova is fertilised by 2 or more sperms. In human, polyspermy is blocked by 2 method :-

① fast blockage (temporary & fast)
② slow blockage (permanant & slow)

Date ___/___/___
Page ___

① Fast blockage



as sperm touch plasma membrane of ova

↓

Na^+ channel present on surface of ova open

↓

Na^+ move from outside to inside causing depolarization

↓

No more sperm can fertilize a depolarize membrane of ova

② Slow blockage

→ Due to depolarization of plasma membrane of 2° oocyte, Ca^{2+} level in cytoplasm increases.

→ Ca^{2+} will cause exocytosis of cortical granules (present in cytoplasm) (cortical reaction)

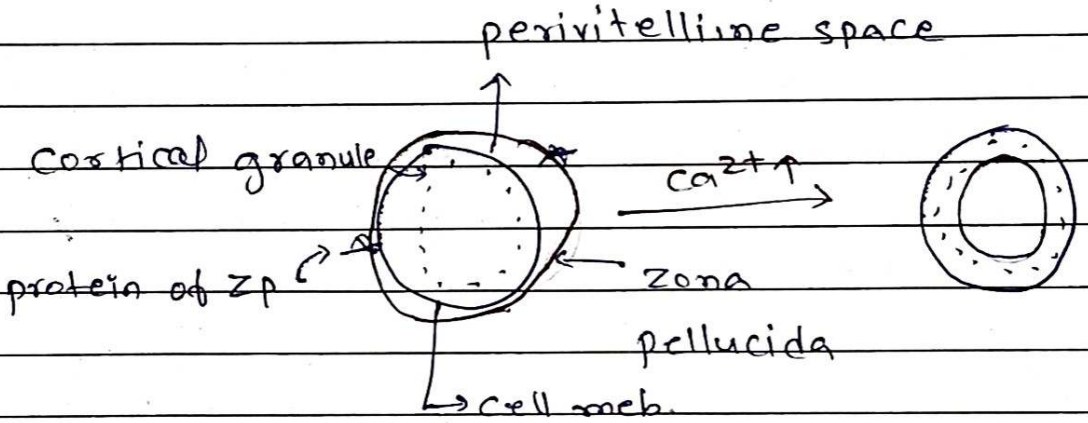
→ Cortical granules enter in perivitelline space and cause ÷

(i) Destruction of protein present on Zona pellucida (Zona reaction)

(ii) Hardening of zona pellucida

→ Due to hardening of zona pellucida, no more sperm can enter in 2° oocyte

→ It is permanant in nature



• Cleavage

→ Rapid mitotic division
→ cell skip growth phase
→ Each cell get equal amount of DNA (2n) but cytoplasmic content decreases.
→ As zygote moves towards uterus, cleavage proceeds

Zygote → 2 cell — 4 — 8 — 16 cell → Blastocyst or Blastula
↓
Morula

Date ___/___/___
Page ___

→ Gastrula

. Blastocyst get implanted in the endometrium of uterus

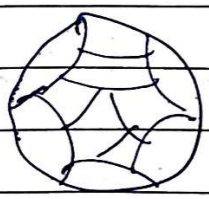
. Morula
→ Solid ball like structure
→ Mulberry like
→ No cavity

. Blastula / Blastocyst
→ hollow ball like
→ cell arranged in → outer layer (trophoblast)
→ inner cell mass
→ blastocoel cavity present

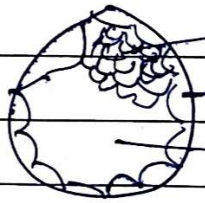
. Gastrula (Gastrulation occurs)
→ formation of 3 germ layers occur ÷
Ectoderm, Endoderm, mesoderm

. Trophoblast of Blastula will help in implantation and placenta formation.

. ICM will participate in formation of embryo.



Morula



Blastocyst

Stem cells

Date ___/___/___
Page ___

* Implantation

→ Blastula get attatched to the endometrium of uterus

→ Uterine tissue also divides and cover the blastula. Due to which blastula get embedded in the endometrium of uterus.

→ Implantation leads to pregnancy

* placenta formation

→ After implantation, finger like projections arise from trophoblast called Chorionic villi which become interdigitated with the mother's uterine tissue and form structural & functional connection b/w mother and developing embryo called placenta

- Functions of placenta :

(i) Provide O_2 and nutrients (→ antibiotic) to developing embryo.

(ii) Remove CO_2 and excretory waste from developing embryo.

(iii) Act as temporary Endocrine body (release hormone : HCG, HPL, estrogen, progesterone)

(iv) Act as barrier so that Maternal and foetal blood cannot get mixed.

Date ___/___/___
Page ___

→ contain artery & vein

→ Umbilical cords connects placenta and growing foetus.

→ During pregnancy, hormones like estrogen, progestrone, thyroxine, cortisol etc increases several fold in the mother's blood for the normal development of the foetus and Healthy mother.

• Hormone by placenta :-

(1) HCG (Human chorionic gonadotrophin)

→ maintain Corpus luteum, acts as LH
→ Detected during pregnancy test in urine of female.

(2) HPL (Human placental lactogen)

→ prepare mammary gland for lactation.

(3) CRF (Corticotrophic releasing factor)

→ Act on adrenal cortex and cause release of cortisol.

Note :- HCG, HPL and relaxin are produced only during pregancy.

Date ___/___/___
Page ___

(4) Estrogen & progestrone

→ Maintain endometrium
→ Development of mammary gland.

* Organogenesis
→ form of organs.

Week
month
Trimester.

- End of 1st month → Heart
- " " 2nd " → limbs, digit
- " " 3rd month/1st trimester → major organ system + external genitals
- End of 5th month → 1st movement, hairs on head
- End of 6th month/2nd trimester → Hair on body, eyelase formed, eyelids seprate
- End of 9th month/3rd trimester → fully developed foetus is ready for parturition

* Parturition (complex neuro-endocrine mechanism)

fully developed foetus & placenta
↳
{ signal

foetal ejection reflex

{

Uterus muscle contract

↓

Signal to mother's hypothalamus, further signal to Neurohypophysis / posterior pituitary

↓

posterior pituitary release oxytocin (birth hormone)

↓

Strong uterine contraction

↓

parturition / Child delivery

→ After delivery of child, placenta is also expelled out

→ Relaxin is release in later phase of pregnancy

- → by ovary !
- → Relax pubic symphysis (aid in child birth)

Note :- Labor can induced by administering pitocin

Date ___/___/___
Page _____

Twin

Monozygotic twins
↳ identical twin

Dizygotic twins
↳ Non- identical twin

Lactation

Hypothalmus → PRH → acts on → anterior pituitary → prolaction → growth of breasts during pregnancy

, PIH → acts on → anterior pituitary → Stop secretion of prolaction → Lactation

date • During the pregnancy other hormone like estrogens, progestogens, cortisol, prolactin, thyroxine etc are increased several folds in maternal blood.

Date ___/___/___
Page ___

- Gastrula
  ↳ Early state of embryo, has an opening called blastopore
- Gastrulation
  ↳ formation of germ layers of embryo is called gastrulation.
- Cells of Rauber (chorion & amnion) & Allantois
  ↳ Connect Trophoblast & inner mass cells
- ↑ Chorionic gonadotropin